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[redacted]

CHAL-0628
Cy 4 of 5

7 April 1959

MEMORANDUM FOR: Deputy Director (Plans)

REFERENCE : Memorandum for DD/P, dated 26 March 1959, Subject: Recommendations Concerning Purchase of the [redacted] (CHAL-0614)

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1. Recommendations in the above reference approved by Mr. Bissell.

2. Pursuant to Administrative Memorandum #116, the attached program documentation form is forwarded for signature.

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[redacted]

Chief, Operations Branch
DPD-DD/P

Att:
Program app req (CHAL-0627)

DPD-DD/P:AES/aem

Dist.:
Cy 1 - addee
Cy 2 - A/C/DPD/DD-P
Cy 3 - Ops/DPD/DD-P(Chal file)
Cy 4 - Ops/DPD/DD-P(subj file)
Cy 5 - Ops/DPD/DD-P(chron file)

USAF review(s) completed.

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(95)

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CHAL-0631
Copy 1 of 7

9 April 1959

MEMORANDUM FOR: Acting Chief, DPD-DD/P

THROUGH : Chief, Administrative Branch, DPD-DD/P

SUBJECT : Project CHALICE - Cover
(Trip Report on Visit to AMS Meeting at Chicago, Illinois)

1. On 27 March 1959, the undersigned attended the 175th meeting of the American Meteorological Society at Chicago, Illinois to monitor the presentation of a scientific paper (copy attached) prepared by Dr. Robert D. Fletcher in support of Project CHALICE cover. As a part of this presentation, a series of film slides showing the various cloud patterns associated with typhoons KIT, WINNIE and IDA were displayed.

2. The reaction of the 500 member audience was most rewarding as extreme interest was displayed over data on the conditions that were associated with the tropical storms discussed in Dr. Fletcher's paper. Though the press was periodically present to cover the AMS meeting during the period 23--27 March, they were not in attendance for this particular session as had been expected. An earlier session had included discussions and papers on Soviet Cloud Physics Research and An Interpretation of the Status of Russian and American Meteorological Research and members of the press were apparently reporting on these topics to their respective papers.

3. The efforts of Dr. Fletcher did not go entirely without journalistic coverage, however, as Dr. David Ludlam, Editor of the Weatherwise magazine was in the audience and agreed most enthusiastically to print a feature article in the next issue. Weatherwise is the official publication of the American Meteorological Society and the article to be published will include photographic copies of each typhoon plus related surface charts that were included in the film slide presentation. The next issue of Weatherwise is due for release on the 15th of April and I have asked to be furnished sufficient copies for our records.

4. I believe Dr. Fletcher made excellent use of our typhoon photography by associating them with future meteorological satellites. As his paper states, current typhoon studies are giving the Air Weather Service their first opportunity to view storm conditions

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from above. It is their intention to develop a Cloud Atlas containing various cloud and storm patterns that will assist them in identifying conditions observed from future weather satellites.

5. The introduction of typhoon research to the CHALICE cover program was most fortunate for it has enabled us to extend the original cover story of Weather Research beyond all expectations. The program under plan at the moment will extend cloud photography into the Middle East where cloud patterns peculiar to that locale will be photographically recorded.

6. It is anticipated that the article in Weatherwise will generate additional requests from other publications. Arrangements have been made with the Office of Information Services, USAF to enable that office to act as the official releasing authority for such photography as may be desired by these other publications. They are being furnished 8" X 10" negatives made from a positive print so that requirements can be met without delay. The Office of Information Services will advise the writer in each instance as to the identity of the requestor and in the case of publications, the date of intended appearance will be cited.

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DPD-DD/P

Attachment: (1) Scientific Paper
Distribution:
1 - Addressee
2 - DD/P
3 - Admin DPD-DD/P
4 - Ops DPD-DD/P
5 - Secur DPD-DD/P
6 - Cover DPD-DD/P
7 - Cover Chrono DPD-DD/P

DPD-DD/P:TMA/sb

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TYPHOON-EYE CLOUD PATTERNS AS VIEWED FROM ABOVE

Robert C. Bundgaard, Robert D. Fletcher, James R. Smith

Air Weather Service

ABSTRACT. Photographs are shown of the cloud covers in and surrounding Typhoons Kit, Winnie, and Ida. Although the patterns vary considerably, all three are characterized by chaotic distributions within the eyes. It is concluded that a meteorological satellite successfully can detect and locate the centers of hurricanes and typhoons and, thereby, be of great assistance to tropical-storm forecasters.

* *

Presumably, one of the greatest immediate benefits of meteorological satellites will consist of presentations of large-scale cloud patterns of meteorological phenomena for use in weather forecasting and research. It is contemplated that patterns ranging in size from single convective-cloud developments to the collective cloud configurations of frontal systems will be recorded and placed at the disposal of the meteorologist.

In particular, it has been suggested that satellites will locate the centers of typhoons and hurricanes. Information as to the latitude and longitude of the eye of a storm, the character of the clouds in the vicinity of the eye and in the spiral bands surrounding it, and time changes in the cloud patterns, will be of tremendous assistance to the forecaster concerned with estimating the future position and extent of the storm. It will also be of great economic value to typhoon-reconnaissance people who no longer will have to search wide areas in locating a possible

storm but, instead, can direct aircraft to the exact location of the center to probe its lower regions for the wind, pressure, temperature, and precipitation data which probably will be beyond the measuring capabilities of satellites for some time to come.

The patterns of low-level winds and pressures in tropical cyclones are well known to meteorologists. So, too, are the cloud and precipitation distributions as determined by radar and by aircraft flying inside the various sectors of the storms. The important question has been raised, however, as to whether typhoons and hurricanes are really identifiable from above--from the vantage point of the satellite. It is the answer to this question which the present paper is concerned in assessing.

The National Aeronautics and Space Administration, with the support of the Air Weather Service, since 1957 has been conducting an upper-air-research program in Japan for the purposes of testing new and improved types of meteorological data. The equipment includes a Perkin-Elmer Model-501 tracking camera to record cloud patterns on 70-mm film. The equipment is mounted in a U-2 jet aircraft capable of flying at heights up to about 10 miles above sea level. Since November 1957, the aircraft has been able to fly over the tops of three separate typhoons and to photograph the cloud patterns of the centers. In each of the three cases the individual photographs have been fitted together into a mosaic showing the configuration of the clouds over the entire eye.

The first flyover, the details of which have been reported by Bundgaard, occurred on 14 November 1957 over Typhoon Kit just north of

the Philippine island of Luzon. Figure 1 shows the cloud picture which was taken. Clearly evident is the general pattern of the clouds spiraling into the center, as is the location of the eye, itself. In the case of Kit, there appear to be several additional cyclonic whirls of which Bundgaard has identified eight. In Figure 2 is the streamline pattern depicting the several vortices.

On 9 July 1958, the Air Weather Service's 54th Weather Reconnaissance Squadron, under Lt. Col. Dale Desper, noted on its synoptic charts a "suspicious area" about 300 miles northwest of Yap Island. The area was reconnoitered by WB-50 aircraft and by 11 July a full-fledged storm, Typhoon Winnie, was located. During the ensuing four days 13 penetrations at 500 mb were made into the center of the storm. On the 15th the typhoon entered Formosa--the most destructive such storm, for the island, of the past decade. Several hours before it reached the east coast of Formosa a U-2 aircraft was dispatched to the storm. It found it could top the clouds of the storm and did so, taking the pictures which form the mosaic shown in Figure 3. In overflying the storm the pilot reported a completely smooth ride, which was quite in contrast to the flights made some six or seven miles lower by the WB-50's which encountered severe turbulence. The eye was a large one; the typhoon winds of its circumference lashed the entire island. The photograph is of the eye itself with the wall clouds discernible in the very corners. The cloud pattern of the eye is very chaotic with two distinct layers clearly evident, one low and the other probably at cirrus levels. The photograph does not show the solid sheet of cirrus surrounding the eye. As described by the pilot there was no detail to this cirrus-cloud cover--only a "solid mist which extended to all horizons."

Typhoon Ida developed near the Mariannas on 21 September 1958. On the 22nd it curved northward and passed over the Tokyo area near midnight of the 26th. When it was just south of Japan its central pressure reached a minimum of 877 mb and the maximum recorded wind was about 140 knots. It was a devastating storm which produced, incidentally, record-breaking precipitation in the Tokyo area. In Figure 4 is shown the track of the typhoon as well as its pressure pattern as it was approaching the island of Honshu. On the morning of the 26th a U-2 aircraft reconnoitered the typhoon. As in the cases of Kit and Winnie, the aircraft found it could clear the cloud tops of Ida and locate the eye of the storm. It made a succession of passes over the eye, the pilot reporting a smooth flight as was the case with Winnie. The photograph of Ida's eye is shown in Figure 5. Here there is no question as to the general circularity of the eye; in this particular picture there is only a suggestion, however, of the spiral cloud bands. The photograph shows a chaotic deck of broken low clouds in the eye with no middle or high clouds except, perhaps, for a few cirrus wisps protruding inward from the north. From the top of the low clouds to the top of the cirrus is estimated to be five to seven miles. The sun's reflection from the side of the cloud wall and top of the low clouds is quite bright--considerably more so than is apparent from the amorphous cirrus of the surroundings. The brightness within the eye is consistent with reports of typhoon-reconnaissance meteorologists who say that they are often blinded upon breaking through the wall of the eye. It also suggests that the excessive reflected radiation may in part account for the abnormally high temperatures frequently reported in the eye of a typhoon or hurricane.

From the three flyover photographs presented in this paper a few tentative conclusions can be drawn as to future satellite observations of typhoons and hurricanes:

1. Usually, although not necessarily always, the spiral structure of the clouds around the eye will aid in locating the center.
2. Usually the eye itself will be identifiable, although at times the existence of secondary vortices will require study by a trained analyst.
3. Usually there will be clouds within the eye; they will be chaotic and broken, with patches of sea surface visible; usually they will be low and often there will be no high clouds.
4. At certain times of the day, and with a center essentially free of high clouds, the eye may appear to the satellite to be a circular region of maximum brightness imbedded in a large area of not-so-bright cloud cover.

Much study is required to determine the optimum resolution for pictures taken from a satellite. Certainly a resolution of one mile and probably one of five miles will suffice for identification of the great majority of hurricanes and typhoons, but a resolution of 50 miles will probably hide the detail necessary for distinguishing the eyes and spiral cloud patterns. Further overflies will be made and more detailed data will be collected to assist in answering this and other important meteorological questions. In an overall sense, the over-the-top photographs of

Kit, Winnie, and Ida indicate that cloud structures of hurricanes and typhoons are such as to make of the satellite an excellent reconnaissanc vehicle for their detection and location.

* *

Reference: Bundgaard, Robert C.; The First Flyover of a Tropical Cyclone; Weatherwise, Vol. 11, No. 3, pp 79-83; June, 1958.